ADULT *CYBISTER FIMBRIOLATUS* ARE PREDACEOUS (COLEOPTERA: DYTISCIDAE)

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ABSTRACT

Predation on tadpoles by adult *Cybister fimbriolatus* was confirmed by field observation. In laboratory testing, adults and larvae devoured larger tadpoles of *Rana berlandieri* at the rates of 0.052 and 0.203 tp/da, respectively; predation rates by adult beetles were much higher on smaller tadpoles. Adults of *Hydrophilus triangularis* were not observed to prey on tadpoles under laboratory conditions, but larvae were observed to consume tadpoles of *Scaphiopus couchi* in the field and of both anuran species in captivity.

Beginning the summer of 1971, I attempted experimentally to ascertain whether several aquatic organisms preyed upon tadpoles of the Rio Grande Leopard Frog, *Rana berlandieri* Cope. While surveying literature on insect feeding habits for a later project, I found a reference which contradicted my observations on *Cybister*. Johnson and Jakinovich (1970) concluded that adults of *Cybister f. fimbriolatus* (Say) were not predaceous, since they did not observe them preying upon a variety of organisms under laboratory conditions. They offered evidence that the beetle was a scavenger. Wilson (1932b) stated that evidence for predation by *Cybister* seemed mostly derived from analogy.

Results from two laboratory experiments are given in this paper. Data for *Hydrophilus triangularis* (Say) adults and *C. fimbriolatus* larvae are included for comparison. These data may seem somewhat inconclusive, for reasons explained below. However, on 12 July 1971 I observed and photographed an adult of *C. fimbriolatus* struggling with a larger *Rana berlandieri* tadpole in amphibian research pond 8 at Brackenridge Field Laboratory (Ideker 1976). The beetle encountered the tadpole while foraging along the pond bottom, attacked by grasping the tadpole with its mandibles, rose to the surface (for air?) while clinging to the struggling tadpole, and returned to the substrate to devour its victim. This field observation lends weight to the data and conclusions presented herein.

METHODS AND MATERIALS

The first experiment ran from May, 1971 to August, 1972. When available, two *Cybister* adults, two late instar *Cybister* larvae, and two *Hydrophilus* adults were run simultaneously in individual, covered fishbowls. A beetle and two medium to large tadpoles of *Rana berlandieri* were maintained per fish bowl. Tadpole total length ranged from about 25 to greater than 60 mm, but not to the extreme size of 10 cm reported by Ideker (1976). At approximately weekly intervals, eaten, dead, or metamorphosing (beyond Stage 42, Gosner 1960) tadpoles were noted and replaced. Boiled lettuce was provided as food for the tadpoles and was available as an al-

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ternative food source for the beetles. Each run continued until death of the beetle, except for a single escaped *Hydrophilus*.

A second experiment surveying potential tadpole predators also included *Cybister*. Other dytiscids such as *Acilius, Copelatus, Desmopachria, Laccophilus,* and *Thermonetus* were observed attacking tadpoles, but data from these genera are not considered here. Six tadpoles (Stages 19 to 25; Rugh 1962, Gosner 1960), a potential predator, and a small piece of boiled lettuce were placed in 2 cm of well-water in a closed 18.5×13×4.5 cm plastic box (Vlchek Plastics, #P-401). After three days, any missing tadpoles were replaced, debris removed, and lettuce added. Controls lacked beetles. All animal material was collected from artificial ponds at the Brackenridge Field Laboratory (BFL) of the University of Texas, within Austin, Travis County, Texas.

Results and Discussion

Table 1 compares data from *Cybister* adults and larvae and *Hydrophilus* adults maintained with medium to large tadpoles (Experiment 1). Feeding rates were 0.043 tp/da for 9 *Cybister* adults, 0.203 tp/da for 13 *Cybister* larvae, and 0.002 tp/da for 6 *Hydrophilus* adults. Tadpoles avoided predators whenever possible. Beetle C3-1 (not listed in Table 1) subsisted 55 days on boiled lettuce alone; the fishbowl lacked tadpoles. This *Cybister* and another were observed actually consuming the lettuce.

Cybister adults: Like Johnson and Jakinovich (1970), Wilson (1923b), and authors cited therein, I did not see adult *Cybister* prey upon tadpoles in over three years of laboratory observations. However, actual field predation was observed on one occasion, as noted above. Moreover, tadpoles repeatedly disappeared from covered fishbowls and closed plastic boxes containing adult *Cybister*. Four *Cybister* adults refused to take tadpoles

Table 1. Feeding data from Cybister adults and larvae and Hydrophilus adults on tadpoles (tp) of Rana berlandieri. Tadpoles > 25 mm, some > 60 mm.

Cybister adults

Beetle	Days Ran	No. tp Eaten	No. tp Met.[1]
C1-1	49	3	0
C2-1	53	0	0
C1-2	53	7	1
C2-2	24	0	0
C1-3	21	0	0
C2-3	110	2	2
C1-4	13	0	0
C1-5	134	5	1
C2-4	235	13	1
Totals	692	30	5

Feeding Rate:

9 beetles: 0.043 tp/da
5 feeders: 0.052 tp/da[4]

Cybister larvae

Beetle	Days Ran	No. tp Eaten	No. tp Met.[1]
L1-1	22	5	0
L2-1	44	15	1
L1-2	38	2	1
L2-2	5	2	0
L1-3	9	2	0
L2-3	46	9	0
L1-4	50	17	0
L2-4	12	1	1
L1-5	13	4	1
L2-5[5]	20	0	0
L1-6	5	0	0
L1-7	21	3	0
L1-8	21	2	0
Totals	306	62	4

Feeding Rate:
13 larvae: 0.203 tp/da

Hydrophilus adults

Beetle	Days Ran	No. tp Eaten	No. tp Met.[1]	dead tp uneaten
H1-1	178	1	5	0
H2-1	52	0	0	0
H1-2	215	0	3	3
H2-2[3]	138	0	3	0
H2-3[3]	43	0	1	1
H2-4	205	1	2	0
Totals	832	2[2]	14	4

Feeding Rate:

6 beetles: 0.002 tp/da

[1] Tadpoles beyond Stage 42 (Gosner 1960) removed to preclude death occurring when froglets could not climb out of water upon completion of metamorphosis.
[2] See details discussed under Hydrophilus adult.
[3] Escaped.
[4] Excludes 4 nonfeeders.
[5] The data for the Cybister larvae may be distorted slightly. Use of late instar larvae may have lowered the feeding rate. L2-5 and L1-6 failed to feed, perhaps because they were last instar larvae at collection. Last instars ready to pupate usually stop eating and then may wander around the fishbowl for 4-6 weeks until they die or find soil of the right moisture content for pupation. In nature they would find a place to purate soon after feeding ceased.

(average beetle survival 28 days). Five of the nine tested consumed a total of 30 tadpoles (average beetle survival 116 days) at the rate of 0.052 tp/da. The individual surviving longest survived 235 days post-capture. Probably only four, possibly six, tadpoles died in *Hydrophilus* bowls in 832 test days. Thus scavenging by *Cybister* adults after tadpole mortality could not account for all missing tadpoles.

Table 2 contains data from the second procedure. *Cybister* adults fed at a higher numerical rate on younger tadpoles. Feeding rates were 0.8 and 0.2 tp/da respectively for the two individuals. The higher numerical feeding rate obtained in this second experiment reflected differences in tadpole size. *Cybister* predation on even smaller newly hatched tadpoles could result in lowered tadpole populations if a sufficient beetle population coincides with frog spawning. In *Rana berlandieri,* the spawning period covers at least 11 months (unpublished data). Thus, adult beetles are present when at least part of the frogs spawned.

Cybister larvae: *Cybister* (and *Dytiscus*) larvae have earned the appropriate appellation of water tigers by virtue of their notoriously voracious attacks on small aquatic vertebrates (Wilson 1923b), other insect larvae (Pennak 1953), and human fingers (personal observations). This study substantiated that reputation. Survival ranged from 5 to 50 days post-capture; larvae were unable to leave the water to pupate. Larvae fed by grasping the tadpoles with forceps-like mandibles, inserting a digestive fluid into the prey, and sucking digested material and body fluids from the prey (Pennak 1953). The carcass of the discarded prey served as evidence of predation.

Hydrophilus larvae: *Hydrophilus* larvae were not found in the permanent BFL ponds studied and thus remained unavailable during this study. Later personal observations showed *Hydrophilus* egg cases and larvae present in temporary rainpools. Early instar larvae preyed on tadpoles of *Rana berlandieri* in the laboratory. The larvae also preyed on tadpoles of Couch's Spadefoot, *Scaphiopus couchi* Baird, in flooded roadsides and in captivity at Elsa, Hidalgo County, Texas. Larvae searched for, manipulated, and devoured pieces of tadpoles as described by Wilson (1923a). Wilson (1923b) reported *Hydrophilus* larvae preying upon Bigmouth Buffalo, *Ictiobus cyprinellus* (Valenciennes) (nomenclature after Hubbs 1972). The habitat observations led me to conclude that the *Hydrophilus* adults collected from BFL ponds had immigrated from temporary pools elsewhere on the grounds or further away.

Hydrophilus adults: Adults of *H. triangularis* primarily scavenged the lettuce while under observation. One of the two apparent records of *H. triangularis* eating a tadpole involved a nibbled tadpole which likely died

Table 2. Feeding data from Cybister adults. Maximum total length of tadpoles of Rana berlandieri (Stages 19 to 25, Gosner 1960) was 12 mm.

Beetle	3 day Runs	Total Tadpoles Eaten	Total Tadpoles Died	No. Tadpoles Eaten Per Run 6 5 4 3 2 1 0	Feeding Rate:
R54-B5	17	40	0	0 3 2 3 2 4 3	0.8 tp/da
R56-B2	15	9	0	1 7 7	0.2 tp/da
Control	17	0	0	17	--
Control	15	0	0	15	--

before the beetle began to eat it. In the other incident the tadpole was completely devoured. Wilson (1923a) recorded the attack and feeding by an adult female on a buffalo in an aquarium.

Conclusions

The disappearance of tadpoles from containers cohabited by *C. fimbriolatus* adults constituted but circumstantial evidence for predation in the eyes of previous authors. However, my field observation of predation of a *Rana berlandieri* tadpole by a *C. fimbriolatus* adult indicates that adult *C. fimbriolatus* indeed are predaceous (being predaceous does not mean a species cannot also be a scavenger or omnivore). Laboratory data indicates that predation rate on larger tadpoles is about 4 times greater by larvae than by adult *C. fimbriolatus,* and that predation rate by adults is greater on smaller than on larger tadpoles.

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